drought tips

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Field Use of Tensiometers

A tensiometer is a device for measuring soil water tension. It consists of a cylindrical pipe about one inch in diameter with a porous ceramic cup attached to one end and a vacuum gauge attached to the other (see Figure 1, below).

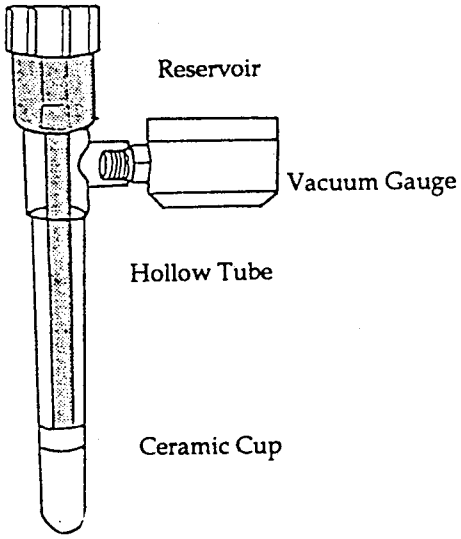

Figure 1. Tensiometer

Why Use Tensiometers?

Tensiometers indirectly measure soil moisture tension. Since tensiometers are installed for the entire season or longer, they provide readings at the same location over an extended period of time. Tensiometer readings are easily interpreted and indicate the soil water conditions experienced by the plants' roots. Soil salinity does not affect the readings.

Although tensiometers are used most frequently for monitoring soil moisture, they can also be incorporated into automated irrigation systems. Gauges with solenoids can be used to control an irrigation system , and tensiometers equipped with transducers can be used with computerized irrigation systems.

Installation

To measure soil water tension, the end of the tensiometer with the porous cup is inserted through a pilot hole in the soil, which has been made with a soil probe. (The porous cup should be soaked in water for several hours before installation.) After installation the tensiometer is filled with water and allowed to equilibrate with the soil water for about twenty-four hours. Tensiometers should be installed in the zone of greatest root density, at about one-quarter to one-third of the maximum root depth. A tensiometer at this depth can be used to schedule irrigations. Table 1 gives tensiometer reading guidelines for various crops. Irrigation should take place when tensiometer readings rise above those listed in the table. Refinements based on soil sampling will be required to adjust for site-specific conditions.

It is recommended that a tensiometer also be installed near the bottom of the root depth to assure that the moisture extends to an adequate depth. If the tensiometer reading at the lower root depth remains unchanged following an irrigation or continues to rise during the growing season, irrigation applications may be insufficient.

The number of stations required depends on the irrigation system and on soil uniformity and management. For areas up to forty acres, at least two stations should be established. Stations should be located in areas representative of overall moisture status, with separate stations for problem areas or for areas having different soil conditions. Areas with different crops should be monitored separately, since water use and root growth differ from crop to crop.

What Do The Readings Mean?

In an unsaturated soil, soil water tension—frequently called the "suction" — falls below atmospheric pressure. As wet soil dries, the soil-water suction increases, causing water to flow out of the tensiometer through the porous cup. The small pores of the saturated cup prevent air from entering the tensiometer. This outflow of water creates a vacuum inside the tensiometer and increases the reading on the vacuum gauge. If the soil is rewetted by irrigation, water will be drawn back into the tensiometer, reducing the vacuum inside, and the reading on the gauge will decrease. The vacuum gauge measures the suction in centibars, with a range of 0 to 100. A reading of zero indicates a saturated soil in which plant roots will

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suffer from poor aeration. A reading of 10 to 25 centibars reflects a soil at field capacity. The lower reading is for sandy soils at field capacity, and the higher reading is for finer-textured soils. Readings of 70 to 80 indicate a dry soil. Tensiometers will not read above 85 centibars.

Tensiometers do not provide information on the amount of water depleted from the soil unless they have been calibrated for the particular soil type. They therefore indicate when to irrigate, but not how much to irrigate.

Table 1. Tensiometer reading guidelines for irrigation.

Crop	Centibars
Alfalfa	70-80
Avocados	40-50
Cantalope	35-40
Celery	20-30
Citrus	50-70
Corn	50-80
Cotton	70-80
Deciduous Trees	60-80
Grapes	40-60
Lettuce	40-50
Tomatoes	60-70
Potatoes	30-50
Small Grains	70-80
(vegetative stage)	40-50

Maintenance

Tensiometers must be properly maintained. This requires periodically filling the pipe with water and replacing porous cups. If the soil becomes too dry (tensiometer readings greater than 85 centibars), the porous cup will break tension and air will enter the tensiometer. A cracked cup will prevent a vacuum from developing in the tensiometer and cause the instrument to always read zero. The porous cup of a tensiometer filled with water should not be exposed to the atmosphere for long periods of time. Such exposure causes evaporation of water from the cup's surface, which in turn causes salt buildup and clogging of the cup.

Purchasing a Tensiometer

Tensiometers are available through local irrigation equipment dealers. They come in standard sizes ranging from 6 to 72 inches. Cost is between $35 and $50. Following is a list of manufacturers who can supply tensiometers:

Irrometer Co., Inc.
P.O. Box 2424
Riverside, California 92516-2424
(7814) 689-1701

Soil Moisture Equipment Corp.
P.O. Box 30025
Santa Barbara, CA 93105
(805) 964-3525

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